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# End-Stop Damper

The invention relates to a door-closing damper, such as is used in the manufacture of furniture, and particularly for furniture doors and drawers.

Damping elements are known from the prior art which are used to let the doors and drawers of furniture return gently into their closed end position. It is intended here to prevent an abrupt and therefore annoying touching of parts of furniture, to limit wear and to obtain a noise- and shock-damping effect.

The known damping elements substantially have an elastic stop element, which is fixed in a blind bore cut into the furniture body. The stop element can also be glued on the furniture body. Such a stop element protrudes past the flat surface of the piece of furniture and, because of its elastic deformability, it lessens the impact of a further furniture element, such as a furniture door, for example.

However, the problem arises, in particular in connection with cabinets hung from a wall with cabinet doors seated in horizontally extending rotating hinges, and with lids which are hingedly connected with chests that, because of their inherent weight, the cabinet doors or covers of the chests impact with a large force on the damping elements applied in the conventional manner. In this case the damping elements are not capable of damping such strong impacts in a satisfactory manner. It is necessary for this purpose for the conventional damping elements to have disproportionally large dimensions, so that a complete closing of the cabinet door would not be possible.

Such a door-closing damper is known from Patent

Abstracts of Japan, Publication No. 2001 140530 A. The known door-closing damper comprises a stop element guided in an elongated damper body with an open and a closed end. The damper body has a receiving chamber for receiving a sliding element, which is connected with the stop element and on whose exterior one or several sliding faces are arranged, which rest against a section of the interior wall of receiving chamber assigned to the open end of the damper body. A sealing device resting against the inner contour of the receiving chamber is arranged on the end of the sliding element projecting into the receiving chamber. The end of the sliding element projecting into the receiving chamber and the sealing device form a hollow space together with the inner contour of the receiving chamber in which, when the sliding element is charged with pressure, a counter-pressure is exerted on the sliding element because of the air pressure being built up in the hollow space. The hollow space has at least one opening for the escape of the air for reducing the air pressure.

In such a door-closing damper the damping effect results from the fact that the opening provided in the form of a bore in the closed end of the damper body has been chosen to be very narrow, so that the air slowly escapes from the hollow space for reducing the air pressure. The typical diameter of such a bore is approximately 0.1 mm. Since door-closing dampers are mostly produced in large quantities by injection-molding methods, and since it is very difficult to make such narrow bores by means of such a production method, the desired damping effect is not dependably provided. Moreover, in actual use problems occur regarding the dimensional accuracy of such narrow bores during continuous

use. This leads to a widening of the bore diameter, and therefore to a worsening of the damping effect.

It is the object of the invention to recite a door-closing damper of the type described above which, with simple construction, assures an effective damping effect even during continuous operation.

This object of the invention is attained by means of the characteristics of claim 1. The dependent claims relate to advantageous further embodiments of the door-closing damper.

Accordingly, it has been provided that a damping member, which constitutes a flow resistance to the air escaping through the opening, works together with the opening. When employing such a damping member it is not necessary to choose the opening, or bore, to be especially small for letting the compressed volume of air escape slowly. Instead, the opening can be selected to be of any arbitrary size, since the air volume flows through the damping member and escapes damped. Openings of a diameter of greater than 0.1 mm can also be realized by an injection-molding process. In order to achieve the desired damping effect, an exactly predefined diameter of the opening is not as important as is the damping member used, instead.

Thus, the damping member can have a porous material as the air flow resistant material. With such a material the air flows through a plurality of narrow flow channels, so that a desired flow resistance is achieved.

In a concrete embodiment, the damping member can have an element made of a sinter metal, a plastic foam, a textile material, a felt material or such material providing a resistance to air flow. An entire list of suitable materials

is available, which differ in regard to their abilities to be processed, to resistibility, to their tendency to be clogged by particles in the air, and other properties of the material. However, it is common to the materials used, that a flow can take place through them and they provide a resistance to flow, which leads to damping in the door-closing damper.

The opening through which flow occurs can be arranged at the closed end of the damper body. It is possible to form the opening in this area by means of a particularly simple manufacturing technology. It is possible in this case to select the diameter of the opening to be from greater than 0.1 mm up to the interior diameter of the hollow space. The damping member can be arranged fitted into a support area formed on the damper body, wherein the entire air flow passes through the damping member. If the interior diameter of the hollow space is selected as the diameter of the opening, the damping member can be directly pressed into the damper body and can define the closed end of the latter. Alternatively or in addition, the opening can be arranged on the sliding element. Since the sliding element extends at least partially into the outer area of the door-closing damper, an opening made in the sliding element assures the particularly good escape of the compressed air from the hollow space. For this purpose it is possible to provide a bore applied in the direction of the extension of the sliding element, which extends as far as the hollow space. The damping member can be arranged fitted into a support area formed in the damper body, wherein the entire air flow passes through the damping member. In this case the damping member can be directly pressed into the bore.

It can be advantageous from the viewpoint of manufacturing technology to arrange the damping member on the side of the opening facing away from the hollow space. If a support area can be formed on the side of the opening facing away from the hollow space, the damping member can be fitted there in a suitable manner.

Alternatively or additionally it is possible to arrange the damping member at the side of the opening facing the hollow space. In that case the support area is located on the same side. A dependable support in the support area is also assured by the preselected flow direction of the air.

The damping member can also be fitted inside the opening. This arrangement is particularly advantageous if the opening has been made with a diameter greater than 0.1 mm.

So that in the state in which it is not charged the sliding element is substantially automatically extended, or remains in the extended position until it comes into contact with a piece of furniture, a spring is provided on the damper body, which is arranged in the receiving chamber. The spring pushes the sliding element at least partially out of the receiving chamber. The sliding element can be easily pushed into the receiving chamber against the spring force. The damping effect is primarily achieved by the air pressure being built up.

In accordance with a particularly advantageous embodiment, the sealing device has at least one elastic sealing lip. When air pressure is being built up in the hollow space which is formed by the end of the sliding element with the sealing device extending into the receiving chamber and the inner contour of the receiving chamber, the

sealing lip is pushed against the inner contour of the receiving chamber, so that a sliding connection is created which is air-tight to a large extent.

An embodiment which is particularly effective and at the same time cost-effective is constituted in that the elastic sealing lip is substantially inclined in the direction toward the closed end of the receiving chamber. In this case the sealing lip is arranged spaced apart, at least partially, from the outer contour of the sliding element and at the end of the sliding element extending into the receiving chamber.

So that the sliding element can be brought into a maximally extended position in spite of the underpressure created in the hollow space in the course of its being pulled out or pushed out by the spring, the sealing lip permits the flow of air into the hollow space. In the course of this, because of the underpressure being created in the hollow space, the elastic sealing lip of the sealing device in the space between the inner contour of the receiving chamber and the outer contour of the sliding element is spaced apart from the inner contour of the receiving chamber in the course of the at least partial pulling-out of the sliding element from the receiving chamber. In this way air can flow through the space between the inner contour of the receiving chamber and the outer contour of the sliding element past the sealing lip into the hollow space. A particularly simply constructed and at the same time effective sliding guidance is created in that at least one protrusion is formed on the inner wall section of the receiving chamber associated with the open end of the damper body, which is in contact with the sliding face(s) of the sliding element. The sliding element is

dependably guided in the receiving chamber, together with the sealing device, which forms a supporting and sealing sliding guidance on the inner wall of the receiving chamber.

So that the sliding element cannot be completely pulled out of the receiving chamber or can be pushed out by the spring, at least one protrusion is formed between the outer contour of the sliding element and the inner contour of the receiving chamber. In the course of the at least partial pull-out of the sliding element from of the receiving chamber, the protrusion strikes the protrusion formed on the inner wall section of the receiving chamber associated with the open end of the damper body. In this way an effective contact stop is formed in an easy way.

For a simple installation of the door-closing damper, the damper body can be inserted into a blind bore in, for example, a furniture body. For limiting the insertion depth of the damper body in the blind bore, the damper body has a shoulder which encircles it at least partially on its outer contour associated with the open end.

For the dependable reception of the spring, the sliding body has an elongated recess which, at least partially, extends substantially in the direction of its longitudinal extension and is arranged at its end associated with the closed end of the receiving chamber, into which the spring arranged in the receiving chamber extends.

So that the hollow chamber between the end of the sliding element extending into the receiving chamber and the inner contour of the receiving chamber, which has been extended by means of the elongated recess in the sliding element, is minimized in the pushed-in state of the sliding element, a pin, which extends in the longitudinal extension

direction of the receiving chamber, has been formed on the inner contour of the closed end of the receiving chamber. In the completely pushed-in state of the sliding element, the pin extends substantially completely into the recess of the element which runs in the direction of the longitudinal extension.

In order to house the spring in a particularly space-saving manner while simultaneously minimizing the volume of the hollow chamber in the pushed-in state of the sliding element, the spring arranged in the receiving chamber can be conducted over the pin and movably arranged on the outer contour of the latter, so that the spring path is not interfered with. At the same time it is possible to form a space between the pin and the recess extending in the longitudinal extension direction in the sliding element, so that the spring is movably arranged on the inner contour of the recess and its spring travel is not hampered.

A particularly effective minimization of the volume of the hollow chamber is achieved in that, with the sliding element substantially completely pushed-in, the spring is squared away in the space between the pin and the recess.

The stop element can have a detent head which projects at least partially over the edge area of the opening at the open end of the damper body and which, with the substantially completely pushed-in sliding element, is stopped on the edge area and in this way defines an additional limit of the insertion depth of the sliding element into the receiving chamber in the damper body.

In the embodiment which is simplest in regard to manufacturing techniques, the sliding body can be designed in one piece with the sealing device.

For example, in order to releasably maintain a cabinet door on the furniture body in the closed position, the stop element can have a magnetic snap-in arrangement or the like contact device for the releasable connection of the door-closing damper.

In accordance with an alternative embodiment variation of a door-closing damper the object of the invention is attained in that the door-closing element has a magnetic snap-in arrangement or the like contact device for the releasable connection of the door-closing damper with a connecting element. Under these cross-sectional conditions it is possible to achieve a continuous pressure reduction with a sufficient damping effect. In this case damping is just large enough so that the door-closing damper can be advantageously employed in furniture construction. In this case it has been shown to be particularly advantageous if it has been provided that the diameter of the opening is less than 0.1 mm.

Such opening cross sections are atypical in connection with the claimed application, and they are very difficult to manufacture. However, with such an embodiment characteristic it becomes possible to definitely act on the varying flow conditions in the pressure release phase, so that good damping is achieved for a door-closing damper.

The invention will be explained in greater detail in what follows by means of exemplary embodiments represented in the drawings.

Shown are in:

Fig. 1, a door-closing damper in a lateral representation and in a sectional view in accordance with a first embodiment, having a damping member arranged at the

closed end of the damper body, and with the sliding element completely extended,

Fig. 2, a door-closing damper in a lateral representation and in a sectional view in accordance with a further embodiment, having a damping member arranged at the sliding element, wherein the sliding element is represented completely extended,

Fig. 3, a door-closing damper in a lateral representation and in a sectional view in accordance with a still further embodiment, having a damping member arranged at the closed end of the damper body, a pin arranged in the hollow chamber, and with the sliding element completely extended,

Fig. 4, a door-closing damper in accordance with Fig. 3 in a lateral representation and in a sectional view, with the sliding element completely pushed in,

Fig. 5, in an enlarged partial lateral representation and in a partial view of Fig. 4 the lower closed area of the damper body with the sliding element completely pushed in, in accordance with the preferred embodiment,

Fig. 6, in an enlarged partial lateral representation and in a partial view of Fig. 4 an area arranged at the outer contour of the damper body at the open end of the receiving chamber in accordance with the preferred embodiment,

Fig. 7, in a partial lateral view and in partial section the upper open area of the damper body with the sliding element completely pushed in, in accordance with an alternative embodiment,

Fig. 8, in a schematic perspective representation a furniture body with a closing flap, which is damped by means of a door-closing damper.

In a lateral representation and in a sectional view, Fig. 1 shows a door-closing damper 10 in accordance with a first embodiment, having a damping member 39a arranged at the closed end 18 of the damper body 14 and with the sliding element 12 completely extended. The door-closing damper 10 has an elongated cylinder-shaped damper body 14 with an upper open end 16 and a lower closed end 18. The damper body 14 has an also cylinder-shaped receiving chamber 20 for receiving the cylinder-shaped sliding element 12, which is connected with a stop element 22. The stop element 22 has a detent head 23, which projects, at least partially, past the edge area 17 of the opening at the open end 16 of the damper body 14 and which, with the sliding element 12 substantially completely pushed in, engages the edge area 17.

The sliding element 12 is provided with a sliding surface on its outer contour 24, which rests against an inner wall section 26 of the receiving chamber 20 assigned to the open end 16 of the damper body 14. A gap 30 is provided between the outer contour 24 of the sliding element 12 and the inner contour 28 of the receiving chamber 20 in the entire section arranged underneath the sliding guide 26. A sealing lip 34 resting against the inner contour 28 of the receiving chamber 20 is arranged at the end 32 of the sliding element 12 extending into the receiving chamber 20. The sealing lip 34 has been produced in one piece with the sliding element 12 by means of a plastic injection process.

The end 32 of the sliding element 12 protruding into the receiving chamber 20 forms a hollow chamber 36 together with the sealing lip 34 and with the inner edge 28 of the receiving chamber 20. A counter-pressure in the direction A, generated by the air pressure being built up in the hollow

chamber 36, is exerted in the hollow chamber 36 when the sliding element 12 is charged with pressure, for example by a (not represented) cover of a chest.

The elastic lip 34 is arranged on the end 32 of the sliding element 12 which projects into the receiving chamber 20. The elastic sealing lip 34 is substantially inclined in the direction toward the closed end 18 of the receiving chamber 20. Thus, the sealing lip 34 extends substantially in the longitudinal direction and parallel with the inner contour of the receiving chamber 20. In the course of this, in its area oriented in the direction to the closed end of the receiving chamber 20, the sealing lip 34 forms a recess 40, approximately ring-shaped in cross section, which is a part of the hollow chamber 20. When air pressure is being built up in the hollow chamber 20, the air pressure within the ring-shaped recess 40 will also rise correspondingly, so that the sealing lip 34 is pressed against inner contour 28 of the receiving chamber 20 and a sliding connection is formed, which is air-tight to a large extent.

When pulling the sliding element 12 at least partially out of the receiving chamber 20, a definite underpressure in respect to the ambient pressure is created in the hollow chamber 36 because of the sealing effect of the sealing lip 34. If in this case the elastic sealing lip 34 is appropriately designed regarding its yielding ability, it can be lifted off the inner contour 28 of the receiving chamber 20 because of the higher air pressure in its surroundings and in the gap 30 in contact with it. In the course of this, air can flow past the sealing lip 34 through the gap 30 between the inner contour 28 of the receiving chamber 20 and the outer contour 24 of the sliding element 12 into the hollow

chamber 36 until a pressure equilibrium has been achieved. The sealing lip 34 can of course also be designed stiff enough that the pressure equalization takes place only via the damping member 39a.

The damper body 14 has a helical spring 42 arranged in the receiving chamber 20, which extends in the receiving chamber 20 from the closed end 18 to the lower end 32 of the sliding element 12. The spring 42 pushes the sliding element 12 at least partially out of the receiving chamber 20. The sliding element 12 can be pushed into the receiving chamber 20 against the spring force of the spring 42.

The sliding element 12 has a recess 44, which extends in the direction of its longitudinal extension and is attached on its end 32 associated with the closed end 18 of the receiving chamber and into which the spring 42 arranged in the receiving chamber 20 extends.

A bottom plate 19, on which the spring 42 is supported and which delimits the hollow chamber 36, has been formed in one piece with the damper body 14 on the closed end 18. An opening 38a in the form of a bore has been cut approximately centered into the bottom plate 19. A damping element 39a made of a porous material, for example a sinter material, is arranged on the side of the bore 38a facing away from the hollow chamber 36. The damping element 39a is used as a flow resistance material for the air flowing out of the opening 38a.

A support area 43a for the damping element 39a is formed on the side of the bottom plate 19 facing away from the hollow chamber 36. The support area 43a is formed as a continuation of the hollow chamber 36, which is separated from the hollow chamber 36 by the bottom plate 19. The

damping element 39a is pressed into the support area 43a in order to avoid false flows bypassing the damping element 39a. Alternatively the damping element 39a can also be glued in or firmly and sealingly connected in a like manner with the support area 43a.

Fig. 2 shows in a lateral view and in section a door-closing damper 10 in accordance with a further embodiment, having a damping element 39b arranged on the sliding element 12, wherein the sliding element 12 is represented fully extended. Now the distinguishing features of the further embodiment of the door-closing damper 10, which are different from the distinguishing features already described by means of Fig. 1, will be more accurately described by means of Fig. 2.

A bottom plate 19 is formed as one piece with the damper body 14 at the closed end 18, against which the spring 42 is supported and which delimits the hollow chamber 36.

A bore 13 as an extension of the elongated recess 44 has been applied to the sliding element 12. In accordance with manufacturing technology, the bore 12a and the recess 44 are designed as a continuous bore applied centered in the longitudinal extension direction of the sliding element.

The cross section of the bore 13 simultaneously defines the opening 35b, in which a damping element 39b, made of a porous material, for example a sinter material, has been arranged. The damping element 39a is used as a flow resistance material for the air flowing out of the opening 38a, and by its position in the bore it defines the extension of the recess 44. The damping element 39a simultaneously is used as a support for the spring 42 within the recess 44.

The support area 43b is constituted by the area of the

inner wall of the bore 13 bordering the recess 44. The damping element 39b has been pressed into the support area 43b in order to avoid false flows bypassing the damping element 39a. Alternatively the damping element 39a can also be glued in or firmly and sealingly connected in a like manner with the support area 43a.

Fig. 3 shows in a lateral representation and in section a still further embodiment of a door-closing damper 10, having a damping member 39a arranged at the closed end 18 of the damper body 14, a pin 46 arranged in the hollow chamber and a completely extended sliding element 12. Now the distinguishing features of this still further embodiment of the door-closing damper 10, which are different from the distinguishing features already described by means of Fig. 1, will be more accurately described by means of Fig. 3.

The sliding body 12 has an elongated recess 44, which extends in its longitudinal extension direction and is attached to its end 32 assigned to the closed end 18 of the receiving chamber and into which the spring 42 arranged in the receiving chamber 20 extends. At the same time a pin 46 has been formed on the inner contour of the closed end 18 of the receiving chamber 20 and extends in the longitudinal extension direction of the receiving chamber 20. The pin 46 has approximately the same length as the elongated recess 44 in the sliding element 12 so that, in the completely pushed-in state of the sliding element 12, the pin 46 extends substantially completely into its recess 44. The spring 42 arranged in the receiving chamber 20 has been conducted over the pin 46 and is movably arranged on its outer contour.

A bottom plate 19 is formed on the closed end 18 and, arranged at right angles and centered thereto, the pin 46 is

formed as one piece with the damper body 14. The spring 42 is supported on the bottom plate 19. An opening 38a in the form of a bore has been cut into the bottom plate 19 laterally next to the pin 46, or the spring 42. A damping element 39a made of a porous material, for example a sinter material, is arranged in a support area 43a on the side of the bore 38a facing away from the hollow chamber 36. The damping element 39a is used as a flow resistance material for the air flowing out of the opening 38a.

In a lateral representation and in section, Fig. 4 shows the door-opening damper 10 in accordance with Fig. 3 with the sliding element 12 completely pushed in. A gap 48 is formed in the sliding element 12 between the pin 46 and the recess 44 extending in the longitudinal extension direction, in which the spring 42 is movably arranged. With the sliding element 12 substantially completely pushed in, the spring 42 is squared away in the gap 48.

For the purpose of a further more detailed explanation, a circle V has been drawn in Fig. 2 around the lower closed section of the damper body 14, which marks the area represented in an enlarged partial lateral representation and in partial section in Fig. 5. Furthermore, another circle VI has been drawn at the upper open section of the damper body 14 in Fig. 4, which marks the area represented in an enlarged partial lateral representation and in partial section in Fig. 6.

In an enlarged partial lateral representation and in partial section of Fig. 4, Fig. 5 shows the lower closed area of the damper body 14 with the completely pushed-in sliding element 12. The hollow chamber 36 shown in Fig. 3 is almost completely occupied by the pushed-in sliding element 12, so

that only the recess 40 constitutes a hollow chamber. Because of the compression action of the sliding element 12 provided with the sealing lip 34, the volume of air from the hollow chamber 36 has flowed through the opening 38a into the damping member 39a and damped, i.e. with an increased flow resistance, through the latter.

Fig. 6 shows in an enlarged partial lateral representation and in partial section of Fig. 4 an area arranged on the outer contour of the damper body 10 at the open end 16 of the receiving chamber 20.

A protrusion 50, which extends approximately ring-shaped on the inner contour of the receiving chamber 20, is formed on the inner wall section of the receiving chamber 20, which is assigned to the open end 16 of the damper body and is in contact with the sliding surface(s) of the sliding element 12. The protrusion can also be constituted by a separate element, for example a retaining ring.

A protrusion 52, represented in Fig. 3, which encloses the sliding element 12 in a ring shape, is arranged on the sliding element 12 between the outer contour 24 of the sliding element 12 and the inner contour 28 of the receiving chamber 20. When pulling the sliding element 12 at least partially out of the receiving chamber 20, this protrusion 52 impacts on the protrusion 50, which is formed on the inner wall section of the receiving chamber 20 associated with the open end 16 of the damper body 14.

In an alternative embodiment, Fig. 7 shows, in an enlarged partial lateral representation and in partial section, the upper open area 16 of the damper body 14 with the sliding element 12 completely pushed in. In this case the sliding element 12 is not provided with a formed stop

element 22, but instead is designed flattened. With this embodiment a cabinet door (not represented) can rest flush against the furniture body (not represented).

In a schematically perspective representation, Fig. 8 shows a furniture body 54 with a closing flap 56, which is damped by means of a door-closing damper 10 in accordance with the embodiment according to Fig. 3. In this case the door-closing damper 10 is arranged on the furniture body 54 in such a way that in the course of the closing movement the closing flap 56 impacts on the door-closing damper 10. The door-closing damper 10 can additionally have a magnetic snap-in arrangement 11 or the like contact device for the releasable connection of the door-closing damper 10 with the closing flap 56. In addition, or alternatively, further (not represented) such contact or closing arrangements can be provided on the furniture body 54 or on the closing flap 56.

The door-closing damper 10 can be inserted into a blind bore in the furniture body 54. In this case the damper body 14 has a shoulder 60, which circles it at least partially, on the outer contour assigned to its open end 16, which limits the insertion depth of the damper body 14 into the blind bore. The shoulder 60 is shown by way of example in Fig. 3.